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# CONSTRUCTING NEW RESEARCH INSTRUMENTS AT THE NRAO

## 1. Introduction.

This note is intended to outline the way the Observatory should carry out the building of new radio telescopes. It covers the construction of:--

(a) The 300-foot antenna planned for building in FY 1961.
(b) The antenna array planned for building in FY 1962.
(c) The start in FY 1962 of the planning, designing and building of the very large antenna and the continuation of this project through to its conclusion, some years later.

## 2. The 300-foot Antenna.

This instrument will be built directly under the control of NRAO staff. In FY 1961 one mechanical engineer (Lindstrom) will work full time on the 300 foot antenna. His efforts will be directed by a senior staff scientist, and this scientist will develop from within and without NRAO a working group, including Lindstrom, to do the design and construction of the antenna.

The size and composition of this group will depend on the relative amounts to be done within NRAO or by outside contract. The group should probably include an electronic engineer and at least one draftsman.

## 3. The Antenna Array.

This array will be built, starting in July 1961, under the part-time direction of a senior staff scientist at the Observatory. He will have at his disposal some of the group already responsible for the 300-foot antenna. This array should not require more than the part-time services of a civil or structural engineer and the part-time services of an electronic engineer, supported by a draftsman and one technician.

## 4. The Very Large Antenna.

By July 1961 there will be a group in residence at NRAO already under scientific leadership and of proven ability by their work on the 300-foot. This group should be the nucleus on which the design, engineering and construction of the very large antenna should fall. The group should start work under a leader at NRAO who is competent and willing to see the project through to completion as quickly as possible. This group leader should report to the Director of NRAO and be responsible to him for the entire design, engineering and construction of the telescope. The group leader would be a Department Chairman at the Observatory. He should be a scientist in close touch with the needs of radio astronomy, capable also of handling the engineering aspects of the project. He would count on receiving and would be responsive to the advice and assistance of the senior scientific and administrative staffs of the Observatory.

Under the project leader would be assembled a group which would grow with the project. The tasks of the group may first be outlined and then an idea given of the kind of staff required.

Task I. Decide what form the antenna should take.

Task II. Prepare a detailed design of the antenna system, including mechanical, structural and electronic engineering aspects.

Task III. Let contracts for the fabrication and erection of all parts of the antenna system.

Task IV. Supervise manufacture, erection and test of the complete antenna system.

To do these tasks the staff and outside contracts needed will vary in the following manner.

Task I. The group will evaluate the technical problems, the probable performance and the cost of two or three of what are considered to be likely antenna systems. In this phase of the work, some very capable and conscientious men must balance cost, complexity and site requirements against the astronomical value of the instrument. To make this evaluation real and purposeful it will be necessary to make experimental tests of critical components and to carry designs to quite an advanced stage. The decision taken at the end of Task I will be both vital and final. The project leader will need the advice and help of astronomers and engineers from outside NRAO and will build a staff within NRAO to do or to get done the detailed work required.

The project leader would probably start Task I by using a working group built of men, some from within NRAO and some from outside. As decisions were made, this group would shed some of its outside help and become the leaders of the group within NRAO for building the antenna. Consultants would remain for work in special areas.

At the end of Task I the group at NRAO would include mechanical, structural, electronic and civil engineers, and would probably be about 10 to 15 at the professional level.

Task II would see a large growth in contracted design work. Whether or not to employ a main engineering firm must be decided at this stage. The decision would rest on the detailed complexity of the antenna system chosen. This phase of the work would end with the production of an engineered design, adequately detailed for soliciting realistic bids and letting firmly written fixed price contracts.

Task III would require considerable administrative and legal help, while Task IV would see the growth of a field inspection force and continued engineering management and supervision.

The following principles, implicit in what has been written, may be restated explicitly.

(a) Direction of the project.

A group, headed by a project leader, who in turn is responsible to the Director of the Observatory, should be built up at Green Bank. Overall management from the start to the end of the project should rest with this group. Subsequent use of the antenna must not remain under the control of this group but should be under the Astronomy Department of NRAO.

(b) The value of time.

The value of time must be understood. Task I will be the hardest to schedule and the hardest to complete. When it is complete, later tasks must be scheduled and controlled with great care. Many aspects of the work will proceed simultaneously. Schedules for all parts of the project will interlock; this in turn will require that all contracts recognise the value of time.

## 5. The Future.

When the large antenna is completed, the size of the group would fall, but the nucleus would remain at NRAO for similar projects.